

## CLAIMS

What is claimed is:

1        1.        A spark plug having at least one electrode connected in series with  
2        a resistor, the resistors having low enough resistance such that pre-  
3        ionization current flows without significantly changing a voltage applied  
4        to the electrode and resistor, the resistance being high enough that the  
5        voltage change on the electrode is substantial once a gap defined by the  
6        electrode is ionized.

1        2.        The spark plug of claim 1, having a plurality of the electrodes and  
2        resistors arranged such that at least one pair of the electrodes form a gap  
3        where the ionization current flows as a result of the voltage and once such  
4        current flow occurs the ions formed in that gap then reduce the  
5        breakdown field needed for ionization current to flow between a second  
6        pair of the electrodes.

1        3.        The spark plug of claim 1, having a plurality of the electrodes and  
2        resistors arranged to form a series of gaps, the size of each gap adjusted to  
3        facilitate ionization current flow to occur one after the other between the  
4        series of gaps.

1        4.        The electrodes of claim 1, having a plurality of the electrodes and  
2        resistors coupled in parallel to the voltage, arranged to form multiple  
3        parallel gaps which are ionized at approximately the same time.

1        5. A spark plug comprising:  
2                a first and a second main electrode, spaced-apart by a distance N,  
3        each electrode for receiving a different potential; and  
4                a plurality of secondary electrodes, disposed between the main  
5        electrodes, each having a gap between one another and the main  
6        electrodes, each gap being different from one another, the sum of the gaps  
7        being equal to the distance N.

1        6. The spark plug defined by claim 5, including a plurality of resistors,  
2        one coupled to each of the secondary electrodes.

1        7. The spark plug defined by claim 6, wherein one of the main electrodes  
2        is disposed through the center of the spark plug, and wherein the resistors  
3        are connected between the center of the spark plug and each of the  
4        secondary electrodes.

1        8. The spark plug defined by claim 6, wherein one of the main electrodes  
2        comprises an outer threaded cylindrical housing, and wherein the  
3        resistors are connected between each of the secondary electrodes and the  
4        outer member.

1        9. The spark plug defined by claims 5, 6, 7 or 8, wherein each of the gaps  
2        have an optimal gap distance, and wherein the actual gap distance is one-  
3        third to two-thirds the optimal gap distance.

1       10. A spark plug comprising:  
2             a main electrode;  
3             a plurality of secondary electrodes, each having a gap from one  
4       another, with a first of the secondary electrodes having a first gap with the  
5       main electrode; and  
6             a plurality of resistors each coupled between a common node and  
7       one of the secondary electrodes.

1       11. The spark plug defined by claim 10, wherein the main electrode is part  
2       of an outer cylindrical housing.

1       12. The spark plug defined by claim 11, wherein the secondary electrodes  
2       are mounted on a generally coplanar surface.

1       13. The spark plug defined by claim 12, wherein the secondary electrodes  
2       are linearly aligned.

1       14. The spark plug defined by claim 10, wherein all the gaps are between  
2       one-third to two-thirds an optimum gap distance.

1       15. The spark plug defined by claim 10, wherein the main electrode is  
2       coupled to a ground potential, and the common node is coupled to a high  
3       potential.

1       16. The spark plug defined by claim 15, wherein each of the gaps is  
2       different from one another.

1        17. The spark plug defined by claim 16, wherein the secondary electrodes  
2        are arranged in a linear configuration.

1        18.    A spark plug comprising:  
2            a first and a second electrode defining a first gap;  
3            a third and fourth electrode defining a second gap, the first and  
4        second gaps near one another;  
5            the first electrode and third electrode being coupled to a first node,  
6        the third electrode being coupled to a first resistor to the first node;  
7            the second electrode and fourth electrode being coupled to a  
8        second node; and  
9            the fourth electrode being coupled to a second resistor to the  
10       second node.

1        19.    The spark plug defined by claim 18, wherein the first gap is larger  
2        than the second gap.

1        20.    The spark plug defined by claim 18, including a fifth and sixth  
2            electrode defining a third gap, the third gap being generally  
3            spaced-apart and parallel to the second gap, and intersecting the  
4            first gap.

1        21.    The spark plug defined by claim 20, wherein the first, second and  
2        third gaps are different from one another.

1        22.    A spark plug comprising:  
2                a first electrode;  
3                a plurality of second electrodes, each having a gap with a first  
4 electrode, each of the gaps having approximately the same distance from  
5 the first electrode, and each having a clear path to the first electrode;  
6                a plurality of resistors, each connecting one of the second electrodes  
7 to a common node.

1        23.    The spark plug of claim 22, wherein the first electrode is coupled to  
2 an outer member of the spark plug, and wherein the common node is  
3 coupled to a high voltage.  
4

1        24.    The spark plug defined by claim 20, wherein the resistors are sized  
2 to induce to a voltage gradient from the first electrode to the second gap  
3 then to the third gap then to the second electrode, during the time when  
4 the second and third gap have sparked but the first gap has not.